PROBLEMS WITH FULL 5 KHz DEVIATION

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Most FM transmitters come from the factory with their internal deviation limiters set set to 5.Ø Khz. If you try to transmit data tones with almost full 5KHz modulation, the deviation limiters will begin to take action and distort your data tones. The amplitude distortion is not very important for AFSK 2Ø2 modem data but any phase distortion will bias your data and even more so with higher speed modems. The two possible solutions are to reset your deviation limiters to say 6.Ø KHz and to only furnish enough modulation audio level for 5Khz of deviation; or to reduce your modulation audio level to below where the deviation limiters have effect, about 4KHz. The second method is more convenient if you are still going to use the transmitter for voice, and the 4KHz deviation has some advantages which I will try to explain.

The actual bandwidth of a FM modulated signal is more than either the deviation or the two sidebands of AM. The FM signal's power is distributed between the carrier and the many sideband pairs which are separated a multiple of the modulation frequency away from the carrier. The distribution of the signal power is a function of the modulation index (peak deviation divided by the modulation frequency) and is given exactly by a rather complicated formula called the Bessel function. The ARRL Handbook has a graph of it and most math books also have it as a table. Consider the values given as voltages, so square the values given for power.

Lets look at the power spectrum of a FM signal modulated with the 2Ø2 modem space tone of 22ØØ Hz.

	dev = 3.96 KHz (MI= 1.8)	dev = 4.84 KHz (MI= 2.2)
carrier	.34ØØ = -9.4dB	.11Ø4 = -19.1dB
+ 2.2KHz sideband	.5815 = -4.7dB	.556Ø = -5.1dB
+ 4.4KHz sideband	.3Ø61 = -1Ø.3dB	.3951 = -8.1dB
+ 6.6KHz sideband	.Ø988 = -2Ø.1dB	.1623 = -15.8dB
+ 8.8KHz sideband	.Ø232 = -32.7dB	.Ø476 = -26.4dB
+11.ØKHz sideband	.ØØ43 = -47.3dB	.Ø1Ø8 = -39.3dB
+13.2KHz sideband	.ØØØ8 = -61.9dB	.ØØ15 = -56.5dB

Even with the new 2ØKHz wide channels, full 5KHz deviation still puts a significant signal into the next channel slot. With an ERP of only 15 watts ten miles away, just that one -39.3dB sideband is 3uV into your two meter receiver tuned to the adjacent channel. By reducing your deviation to 4Khz, you can avoid any deviation limiter distortion and also reduce interference to adjacent channels by 8dB at the cost of only a 2dB reduction in demodulated audio.

* Path Loss = 36.6dB + 2Ø LOG(MHz) + 2Ø LOG(Miles)
  1.Ø uV = -137dB Watts